



## UNITED STATES PATENT AND TRADEMARK OFFICE

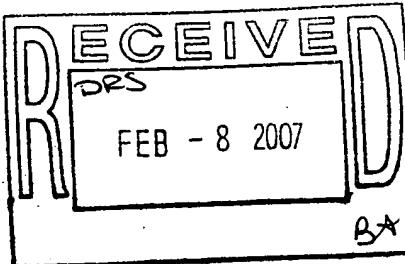
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U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
10/568,241	Donald James Highgate	GJE-7555

23557	INTERNATIONAL APPLICATION NO.
	PCT/GB04/03570

PO BOX 142950	I.A. FILING DATE	PRIORITY DATE
GAINESVILLE, FL 32614-2950	08/19/2004	08/22/2003

23557  
 SALIWANCHIK LLOYD & SALIWANCHIK  
 A PROFESSIONAL ASSOCIATION  
 PO BOX 142950  
 GAINESVILLE, FL 32614-2950



Date Mailed: 02/05/2007

CONFIRMATION NO. 9552  
 371 FORMALITIES LETTER



\*OC000000022328440\*

### NOTIFICATION OF MISSING REQUIREMENTS UNDER 35 U.S.C. 371 IN THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

The following items have been submitted by the applicant or the IB to the United States Patent and Trademark Office as a Designated / Elected Office (37 CFR 1.495).

- Copy of the International Application filed on 02/14/2006
- Copy of the International Search Report filed on 02/14/2006
- Copy of IPE Report filed on 02/14/2006
- Copy of Annexes to the IPER filed on 02/14/2006
- Preliminary Amendments filed on 02/14/2006
- Information Disclosure Statements filed on 12/27/2006
- Oath or Declaration filed on 02/14/2006
- Request for Immediate Examination filed on 02/14/2006
- U.S. Basic National Fees filed on 02/14/2006
- Priority Documents filed on 02/14/2006
- Specification filed on 02/14/2006
- Claims filed on 02/14/2006
- Abstracts filed on 02/14/2006
- Drawings filed on 02/14/2006

The applicant needs to satisfy supplemental fees problems indicated below.

The following items **MUST** be furnished within the period set forth below in order to complete the requirements for acceptance under 35 U.S.C. 371:

- Oath or declaration of the inventors, in compliance with 37 CFR 1.497(a) and (b), identifying the application by the International application number and international filing date. The current oath or declaration does not comply with 37 CFR 1.497(a) and (b) in that it:
  - is not executed in accordance with either 37 CFR 1.66 or 37 CFR 1.68.

- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.492(h) of \$130 for a non-small entity, must be submitted with the missing items identified in this letter.

**SUMMARY OF FEES DUE:**

Total additional fees required for this application is \$130 for a Large Entity:

- **\$130 Surcharge.**

Additionally the following defects have been observed:

- Annexes have not been entered because they were not a page-for-page substitution.

**ALL OF THE ITEMS SET FORTH ABOVE MUST BE SUBMITTED WITHIN TWO (2) MONTHS FROM THE DATE OF THIS NOTICE OR BY 32 MONTHS FROM THE PRIORITY DATE FOR THE APPLICATION, WHICHEVER IS LATER. FAILURE TO PROPERLY RESPOND WILL RESULT IN ABANDONMENT.**

The time period set above may be extended by filing a petition and fee for extension of time under the provisions of 37 CFR 1.136(a).

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.  
<https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html>

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at <http://www.uspto.gov/ebc>.

**If you are not using EFS-Web to submit your reply, you must include a copy of this notice.**

KAREN R MCLEAN

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Telephone: (703) 308-9140 EXT 214

**PART 1 - ATTORNEY/APPLICANT COPY**

U.S. APPLICATION NUMBER NO.	INTERNATIONAL APPLICATION NO.	ATTY. DOCKET NO.
10/568,241	PCT/GB04/03570	GJE-7555

FORM PCT/DO/EO/905 (371 Formalities Notice)

5 Mar '06 12:34  
15 Jun 03 09:52

itm POWER PLC Cambridge  
User

01799#531497

p.2

U1100 U75100



itm POWER LTD  
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Lindsey Harrison  
115 Gell Street  
Sheffield  
S3 7QT

Villa Farm  
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Sleaford  
PE9 3DY

12<sup>th</sup> June 2003

phone  
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fax  
+44(0)1780 749168  
email  
info@itm-power.com  
website  
[www.itm-power.com](http://www.itm-power.com)

Dear Lindsey,

We are very pleased to welcome you to ITM Power for the Summer and are looking forward to what we hope will be a very interesting project for both you and the company.

We have spoken to Business Link today who recommends that the best way for us to engage your services is as a consultant and to this end we have prepared the enclosed consultancy agreement.

As ITM Power is a research and development company patents and IPR are very important to the business, consequently clauses 8 and 9 of the consultancy agreement are fairly lengthy. If you have any questions regarding them or indeed any other issues please don't hesitate to contact me. Otherwise please return a signed copy of the agreement to me at the address above.

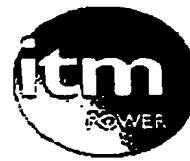
We have been given a brief summary of your achievements to date but I would be very interested to see your full CV.

I shall be visiting the Sheffield labs in the next few weeks and looking forward to seeing you there.

Yours sincerely,

RJ Wreford

John Wreford  
Managing Director



ITEM POWER LTD  
Cambridgeshire UK

Lindsey Harrison  
115 Gell Street  
Sheffield  
S3 7QT

Villa Farm  
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12<sup>th</sup> June 2003

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fax  
+44(0)1780 749168  
email  
info@itm-power.com  
website  
www.itm-power.com

Dear Lindsey,

#### **CONSULTANCY AGREEMENT**

We are delighted that you will be working with us as part of the 2003 STEP Programme to review ITM's opportunities in the photo-voltaics industry.

Our terms and conditions relating to this agreement are as follows.

##### **1. COMMENCEMENT DATE**

Your engagement will commence on the 16th June 2003 for a period not exceeding 13 weeks terminating on the 12<sup>th</sup> September 2003 at the latest.

##### **2. PROJECT**

Your project will be to review ITM's opportunities in the photo-voltaics industry and recommend strategic alliances for research and development of ITM's ionic polymer technology.

##### **3. FEES**

We will pay you a fee of £170.00 per week, paid monthly in arrears by cheque. For the avoidance of doubt your fees will be exclusive of VAT. Please ensure that your invoice arrives at least one week before the payment date.

##### **4. EXPENSES**

The Company will reimburse you for all hotel, travelling and out of pocket expenses reasonably and properly incurred by you in the provision of your consultancy services within the UK, excluding travel to your normal place of work. Major sums of expenditure (such as overseas travel) should be authorised by the Company beforehand. You will be provided with the Company's standard expense claim form and you should provide the Company with copies of relevant receipts. Your total expenses for any given month should be included on your monthly invoice.

##### **5. HOURS AND PLACE OF WORK**

Your normal working hours will be 9.00 to 5.00pm, Monday to Friday.

Your normal place of work will be at our Sheffield Laboratory - Suite F, Sheffield City Airport, Europa Link, Sheffield, S9 1XZ.

Continued



## 6. INDEPENDENT CONTRACTOR

- 6.1. This agreement does not constitute an employment relationship between you and the Company and no employment rights whatsoever will result from carrying out this agreement.
- 6.2. You will be responsible for settlement with the Inland Revenue of any income tax and NIC related to the fees payable under this Agreement.

*The following clauses also relate to any information, inventions and creative works concerning our associated companies DRFP Holdings Limited (Copia Medical Limited), Dental Root Filling Products Limited, Grovewalk Limited, ITM Energy Limited, Smartwood Limited and SMP Limited.*

## 7. CONFIDENTIAL INFORMATION

- 7.1. You must not make use of, divulge or communicate to any person howsoever (save in the proper performance of your duties under this Agreement) any of the trade secrets or other confidential information of or relating to us or our customers, suppliers or clients which you may have received or obtained whilst in employment with us. This restriction shall continue to apply after the termination of your employment without limit in point of time but shall cease to apply to information ordered to be disclosed by a court of competent jurisdiction or otherwise required to be disclosed by law.
- 7.2. For the purposes of this Agreement confidential information will include, but will not be limited to our trade secrets, operations, processes, financial information, marketing strategy, manufacturing processes, information technology, designs, plans, formulae, technology, client details, supplier details, pricing structures and agreements and any other information relating to us or our employees, clients, customers or suppliers which is confidential (either because we tell you it is confidential or you ought reasonably to know that it is confidential).

## 8. INVENTIONS AND CREATIVE WORKS

- 8.1. During the course of your consultancy and as part of your duties you acknowledge that:-
  - 8.1.1. you may conceive or make, individually or with others, certain inventions, ideas, discoveries, developments, writings, trade marks, service marks, designs, drawings, improvements and innovations, whether or not patentable or capable of registration in some other way (collectively "Inventions"); and
  - 8.1.2. you may develop or produce, individually or with others, certain works in which copyright and/or unregistered design right will subsist in various media, including but not limited to electronic materials (including but not limited to software or instruction manuals), (collectively "Creative Works").
- 8.2. You will promptly disclose to the Company in writing all Inventions and Creative Works and shall not disclose the same to any third party without the prior written consent of the Company.
- 8.3. You acknowledge that any and all Inventions or Creative Works and Intellectual Property subsisting or which may in the future subsist in them whether or not conceived or made during working hours, including, without prejudice to the generality of the foregoing any that:-
  - 8.3.1. relate in any manner to the business of the Company or to its actual or anticipated activities;
  - 8.3.2. result from or are made in the course of your engagement; or

Continued



- 8.3.3. involve the use of any equipment, supplies, facilities, Confidential Information, Intellectual Property or time of the Company;
- 8.3.4. will on creation, subject to the provisions of the Patents Act 1977, vest in and be the exclusive property of the Company in the United Kingdom or any other part of the world and where the same does not automatically vest in accordance with this Clause you hereby agree to unconditionally assign the same to the Company or in the case of any future copyright in the same you assign such copyright to the Company absolutely.
- 8.4. You agree that, without prejudice to the generality of the foregoing:-
- 8.4.1. any Invention disclosed by you to a third person or described in a patent or registered design application or registered trade mark or service mark application filed by you, (alone or jointly) or on your behalf; and
- 8.4.2. any Creative Work disclosed to a third person, published or the subject of an application for registration filed by you (alone or jointly) or on the your behalf;
- 8.4.3. within the period of 6 months following termination of this Agreement for whatever reason will be presumed to have been invented, created, written, developed, produced, conceived or made by you during the period of this Agreement, unless proved by you to have been invented, created, written, developed, produced, conceived or made by you after the termination of this Agreement.
- 8.5. You irrevocably waive any rights which you may have in the Inventions or the Creative Works which are or have been conferred on you by Chapter IV of Part I of the Copyright, Designs and Patents Act 1988 headed "Moral Rights" and by any other laws of a similar or equivalent nature in any of the countries in the world.
- 8.6. You shall immediately upon the request and at the expense of the Company execute such specific assignments of any Invention or Creative Works and execute, acknowledge and deliver such other documents and take such further action as the Company may require, at any time during or subsequent to the period of your employment, to vest or evidence title in any or all of the Inventions or Creative Works in the Company and to obtain, maintain and defend the Intellectual Property in the Inventions or Creative Works in any and all countries of the world or to otherwise give effect to the provisions of this Agreement.
- 8.7. You irrevocably and unconditionally appoint the Company as your attorney in your name and on your behalf to execute and do any such instrument or thing and generally to use your name for the purposes of giving to the Company or its nominee the full benefit of the provisions of this Clause and acknowledges in favour of any third party that a certificate in writing signed by any Director or the Secretary of the Company that any instrument or act falls within the authority hereby conferred shall be conclusive evidence of that fact.
- 8.8. You shall not knowingly do, permit or suffer to be done any act or thing or omit to do any act or thing which might jeopardise or prejudice any of the rights conferred on or vested in the Company by virtue of this Clause or any document signed executed and delivered pursuant to this Clause or which might invalidate or prejudice any application made by the Company for a patent, registered design, copyright, design right or other similar right in any part of the world.
- 8.9. You agree not to disclose without the Company's consent any information or know-how or knowledge gained from the Company as a result of this agreement and in addition that any developments arising from your work with the Company under this agreement shall be considered the property of the Company unless otherwise agreed.

Continued

- 8.10. The Company recognises that you are a research employee of a U.K. University with all the rights and obligations which stem from this. In order to avoid conflict(s) of interest between the Company and any of your employer(s) from time to time, inter alia, your present University, you should immediately inform the Company if you believe that any part of your other employment constitutes a conflict of interest whether of a technical or commercial nature with the business of the Company.
- 8.11. The obligations of confidentiality set out in this agreement shall not apply to any information that
- 8.11.1. was known to you before the information was imparted by the company; or
- 8.11.2. is in or subsequently comes into the public domain through no fault on your part; or
- 8.11.3. is received by you from a third party lawfully entitled to make the disclosure to you; or
- 8.11.4. is developed by any of your colleagues or students who have not had any direct or indirect access to information imparted by us

If you are in agreement with the above please sign and return the second copy of this letter to me at the above address.

Yours sincerely

*H. P. HARRISON*

John Wreford  
for and on behalf of ITM Power Ltd

I accept the above terms

*L. Harrison*  
Lindsey Harrison

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AIR MAIL



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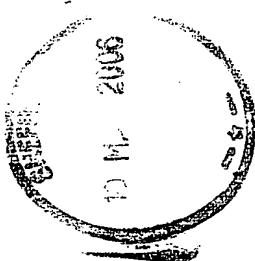
8 May 2006

Lindsey Harrison  
115 Gell Street  
Sheffield  
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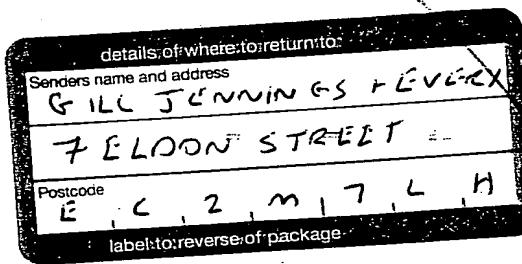
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8 May 2006

Lindsey Harrison  
115 Gell Street  
Sheffield  
S3 7QT

BY RECORDED DELIVERY

Dear Ms Harrison

**US Patent Application No. 10/568241**

**ITM Fuel Cells Ltd.**

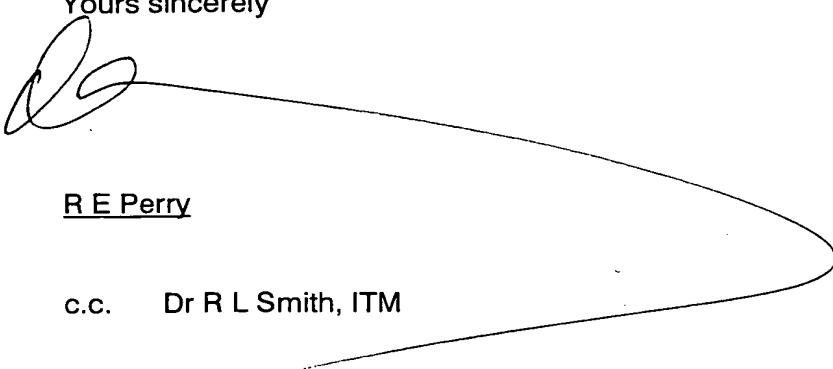
**Our Ref: REP07555US**

**ITM Ref: ITM003**

In order to complete the formalities for this Application, on which you are named as one of the inventors and at the request of Rachael Smith at ITM, I ask that you sign the enclosed Declaration and Assignment forms, where indicated. I also enclose a copy of the specification describing the invention, for your ready reference.

Please sign the forms where indicated and send the signed forms to me in the enclosed stamped addressed envelope. I look forward to hearing from you very soon.

Yours sincerely



R E Perry

c.c. Dr R L Smith, ITM

**Gill Jennings & Every LLP**

**European Patent Attorneys**  
**European Trade Mark Attorneys**

Broadgate House  
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EC2M 7LH

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**Consultant:**  
P R B Lawrence

**Associates:**  
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A J M Smee  
L C Stewart  
R G Price

**Partnership Secretary:** S J Pack

**Accounts:** A J Shiafkou  
**IT Systems:** G G Amabilino  
**Patent Formalities:** A A Heathcote  
**Records:** Patents: G M Alderman  
**Trade Marks:** J H Bedding

---

**Also at:** Alicante  
Cambridge  
Munich

---

Gill Jennings & Every LLP is registered in England and Wales as a Limited Liability Partnership.  
Registered No. OC313165  
Registered Office: Broadgate House,  
7 Eldon Street, London EC2M 7LH

USA

DECLARATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of subject matter which is claimed and for which a patent is sought on an invention entitled

**PHOTOVOLTAIC CELL**

the specification of which  is attached hereto or

was filed on 19 AUG 04 as United States Application Number or PCT International Application Number PCT/GB2004/003570 and was amended on 28 SEP 05 (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for a patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application Number(s)	Country	Foreign Filing Date	Priority Not Claimed	Certified Copy Attached?
			YES	NO
0319799.3	GB	22 AUG 03	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

I hereby appoint the following persons registered to practice before the Patent and Trademark Office as my attorneys with full power of substitution and revocation to prosecute this application and all divisions and continuations thereof and to transact all business in the Patent and Trademark Office connected therewith who are associated with **Customer Number 23557**.

The attorneys/patent agents currently associated with this Customer number are: David R. Saliwanchik, Reg. 31,794; Jeff Lloyd, Reg. 35,589; Doran R. Pace, Reg. 38,261; Jay M. Sanders, Reg. 39,355; Jean E. Kyle, Reg. 36,987; James S. Parker, Reg. 40,119; Frank C. Eisenschenk, Reg. 45,332; Glenn P. Ladwig, Reg. 46,853; Margaret Efron, Reg. 47,545; Gwendolyn L. Daniels, Reg. 51,594; John M. Sanders, Reg. No 30,126; and Jenna M. Morrison, Reg. No. 55,468

Direct all correspondence to:  
Saliwanchik, Lloyd & Saliwanchik  
3107 S.W. Williston Road  
Gainesville, FL 32608  
USA

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C 1001 and that such willful false statements may jeopardise the validity of the application or any patent issued thereon.

Full name of sole or  
First Inventor      Donald James HIGHGATE

Inventor's signature \_\_\_\_\_

Residence address      Surrey RH5 6NS, United Kingdom

Post Office address      The Wilderness, Holmbury Hill Road, Holmbury St Mary, Dorking,  
Surrey RH5 6NS, United Kingdom

Country of Citizenship      United Kingdom      Date of signature \_\_\_\_\_

Full name of  
Second Inventor      Lindsey HARRISON

Inventor's signature X \_\_\_\_\_ X

Residence address      Sheffield S9 1XU, United Kingdom

Post Office address      ITM Power plc, Unit H, Sheffield Business Park, Europa Link,  
Sheffield S9 1XU, United Kingdom

Country of Citizenship      United Kingdom      Date of signature X X

Full name of  
Third Inventor      Simon BOURNE

Inventor's signature \_\_\_\_\_

Residence address      Sheffield S9 1XU, United Kingdom

Post Office address      ITM Power plc, Unit H, Sheffield Business Park, Europa Link,  
Sheffield S9 1XU, United Kingdom

Country of Citizenship      United Kingdom      Date of signature \_\_\_\_\_

# Assignment

USA

**Name(s) of Inventors**

(1) Donald James HIGHGATE

(2) Lindsey HARRISON

(3) Simon BOURNE

In consideration of the sum of one dollar (\$1.00) and other good and valuable consideration paid to each of the undersigned, the undersigned agree(s) to assign, and hereby do(es) assign, transfer and set over to

Name of Assignee **ITM FUEL CELLS LTD**

Address of Assignee      Orkney House, Great Chesterford Court,  
Great Chesterford, Saffron Walden CB10 1PF, United Kingdom

(hereinafter designated as the Assignee) the entire right, title and interest for the United States, its territories, dependencies and possessions, in the invention, and all applications for patent and any Letters Patent which may be granted therefor, known as

**Title** PHOTOVOLTAIC CELL

for which the undersigned has (have) executed an application for patent in the United States of America

**Date of Signing**

### **Engineering of Application**

- 1) The undersigned agree(s) to execute all papers necessary in connection with the application and any continuing or divisional applications thereof and also to execute separate assignments in connection with such applications as the Assignee may deem necessary.
  - 2) The undersigned agree(s) to execute all papers necessary in connection with any interference which may be declared concerning this application or continuation or division thereof and to cooperate with the Assignee in every way possible in obtaining evidence and going forward with such interference.
  - 3) The undersigned agree(s) to execute all papers and documents and perform any act which may be necessary in connection with claims or provisions of the International Convention for Protection of Industrial Property or similar agreements.
  - 4) The undersigned agree(s) to perform all affirmative acts which may be necessary to obtain a grant of a valid United States patent to the Assignee.
  - 5) The undersigned hereby authorise(s) and request(s) the Commissioner of Patents to issue any and all Letters Patents of the United States resulting from said application or any division or divisions or continuing applications thereof to the said Assignee, as Assignee of the entire interest, and hereby covenants that he has/she has (they have) full right to convey the entire interest herein assigned, and that he has/she has (they have) not executed, and will not execute, any agreements in conflict herewith.
  - 6) The undersigned hereby grant(s) to the attorney(s) identified in the Declaration/Power of Attorney for this patent application, the power to insert on this assignment any further identification which may be necessary or desirable to comply with the rules of the U.S. Patent and Trademark Office for recordation of this document.

In witness whereof, executed by the undersigned on the date(s) opposite the undersigned name(s).

Date \_\_\_\_\_ Signature of Inventor (1) \_\_\_\_\_

Date: \_\_\_\_\_ Signature of Inventor (2)

Date X Witness X

Date                  Witness

## PHOTOVOLTAIC CELL

### Field of the Invention

This invention relates to a photovoltaic cell.

### Background of the Invention

5 A photovoltaic cell converts light energy into electrical energy, the "photovoltaic effect" being the process through which light energy is converted into electrical energy. Photovoltaic cells are typically solid state devices, usually semiconductors such as silicon. Usually one or more photosensitive electrodes are irradiated, simultaneously generating a voltage and a current.

10 Electrochemical cells may be in the form of a membrane electrode assembly (MEA), i.e. a cathode/membrane/anode assembly. MEAs typically have a multi-layered structure comprising (i) an Ion Exchange Membrane (IEM), (ii) a current-collecting electrode, and (iii) an electro-catalyst layer on each side.

WO-A-03/023890 describes a composite MEA formed by an *in situ* polymerisation process. This publication further describes an MEA having an improved reaction interface.

### Summary of the Invention

The present invention addresses the need for an efficient method of generating electrical energy via the photovoltaic effect. The invention involves  
20 the use of a MEA capable of transmitting light.

A first aspect of the invention is a photovoltaic cell which is a membrane electrode assembly capable of transmitting light. The membrane material is preferably a polymer comprising a strongly ionic group. The assembly preferably comprises a catalyst and/or a dye sensitiser.

25 A second aspect of the invention is a method for generating a voltage, which comprises irradiating a cell of the invention.

### Description of the Preferred Embodiments

The term "photovoltaic cell" as used herein refers to a cell which is capable of converting light energy into electrical energy.

30 The term "membrane electrode assembly" as used herein refers to a cathode/membrane/anode assembly.

The membrane may be capable of transmitting light. For example, the membrane may comprise one or channels for the transmission of light or may be optically transparent, preferably optically clear. The membrane material may be transparent to photons, e.g. high energy, visible or UV radiation. It is preferably 5 malleable, so that it can be formed into shapes which focus, concentrate and direct light as desired. Thus, for example, the MEA may be in the form of a light waveguide or lens.

The membrane material preferably comprises a polymer which includes a strongly ionic group. The membrane may be formed by the polymerisation of 10 monomers which include monomers such as hydroxyethyl methacrylate (HEMA), acrylonitrile (AN), methyl methacrylate (MMA), 2-acrylamido-2-methyl-1-propanesulphonic acid (AMPSA) and/or vinyl pyrrolidone (VP).

The material may be formed by the copolymerisation of monomers which include an electrically active comonomer. The electrically active component can 15 be based either upon an acid, e.g. a sulphonic acid ( $\text{SO}_3$ ), phosphoric or phosphonic acid, or an alkali (OH), e.g. KOH or NaOH or ammonium hydroxide. If electrically inactive comonomers are used, the material may be rendered electrically active by introducing strongly ionic molecules, for example using a swelling liquid technique.

20 Water can be used to cool the cell, maintain hydration and carry away excess energy as heat energy. Accordingly, the polymer is preferably hydrophilic, such that it is inherently able to absorb and transmit water throughout its molecular structure. Hydrophilic polymers can typically be formed by the copolymerisation from solution of a monomer mixture normally consisting 25 of a hydrophobic/structural comonomer and a hydrophilic comonomer. The polymer is preferably cross-linked for greater stability. Cross-linked materials may be formed by applying ionising radiation to the material or by using a cross-linking agent. The use of additional cross-linking agents allows the final water uptake to be controlled separately from the electrical properties. The membrane 30 may comprise integrated channels for the transmission of water.

The assembly may comprise a suitable catalyst. Preferred catalysts include platinum and titanium dioxide. A dye sensitiser such as ruthenium (II)

tris(2,2'-bipyridine)dichloride hexahydrate (ie. a compound of  $\text{Ru}(\text{bpy})_3^{2+}$ ), iodine or an iron complex with a suitable quenching compound (e.g. methyl violagen) may be used. Preferably, the sensitiser is disposed throughout the membrane. Any catalyst is preferably disposed on or near an electrode.

5 An electrode may be translucent, transparent (e.g. a tin oxide glass) or of an "open-weave" construction, to allow the transmission of photons through the electrode to reach the membrane. A carbon fabric may be used as an electrode, and the fabric may be impregnated with a layer of catalyst. The assembly may be in the form of a stack of individual MEAs.

10 Further information regarding suitable materials and processes for the formation of MEAs may be found in WO-A-03/023890.

The following Examples illustrate the invention.

Example 1

15 A cell of the invention was constructed using an AN-VP-AMPSA copolymer membrane. The electrode-catalyst systems used were tin oxide glass coated with titanium dioxide and carbon fabric coated with platinum. The cell is depicted in Figure 1.

20 A "blue" lamp (100 W electrical output) was used to illuminate the cell. The output of the cell was measured and was found to depend entirely on the presence of light, giving an open circuit voltage of 0.59 V. The resulting current was dependent upon the light flux, reaching a maximum of  $0.22 \text{ mA/cm}^2$ .

Example 2

25 A cell similar to that of Example 1 was produced, except that the membrane was formed by thermal polymerisation of the monomers *in situ* with the glass electrode plate.

The cell was irradiated as before, giving an open circuit voltage of 0.78 V.

CLAIMS

1. A photovoltaic cell which is a membrane electrode assembly capable of transmitting light.
2. A cell according to claim 1, wherein the membrane is a material comprising a polymer, the polymer comprising a strongly ionic group.
3. A cell according to claim 2, wherein the polymer is hydrophilic.
4. A cell according to claim 2 or claim 3, wherein the polymer is cross-linked.
5. A cell according to any preceding claim, wherein the membrane is a malleable material.
- 10 6. A cell according to any preceding claim, wherein the assembly is in the form of a stack.
7. A cell according to any preceding claim, wherein the assembly comprises a catalyst.
8. A cell according to claim 7, wherein the catalyst comprises platinum and/or titanium dioxide.
- 15 9. A cell according to any preceding claim, wherein the membrane comprises a channel suitable for the transmission of light.
10. A cell according to any preceding claim, wherein the membrane is optically transparent.
- 20 11. A cell according to any preceding claim, wherein the assembly comprises a dye sensitiser.
12. A cell according to any preceding claim, wherein the assembly is planar in structure.
13. A cell according to any preceding claim, wherein an electrode is transparent.
- 25 14. A method for generating a voltage, which comprises irradiating a cell according to any of claims 1 to 13

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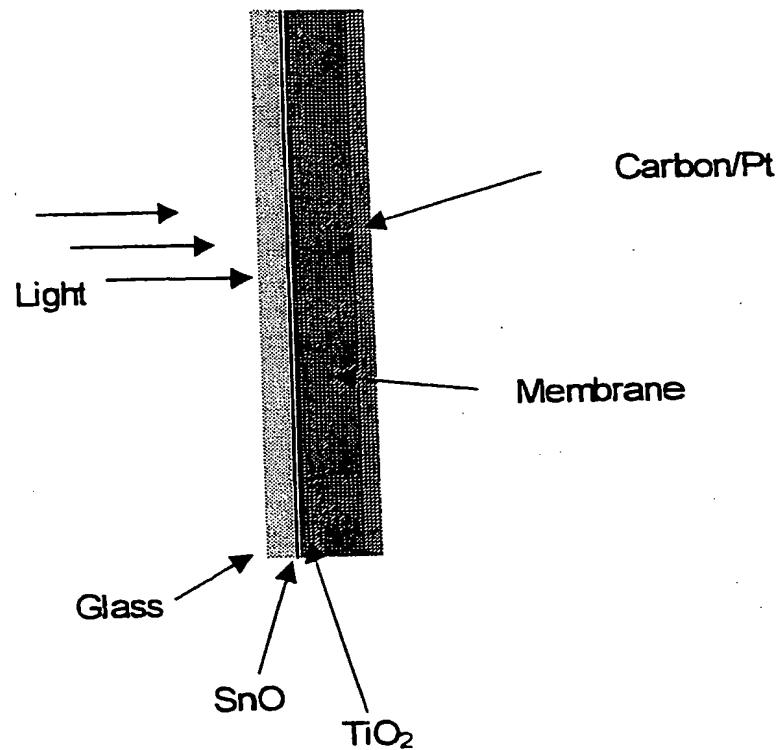


Figure 1